Scaling volumes help CPV gain credibility

Medical Design Technology

Those weren't the sorts of countries or the sorts of install-and-forget systems that got jump started by European feed-in tariffs, so the technology has yet to get real market traction, with only some 20MW installed worldwide in 2010. Another sign of the market's limited enthusiasm for CPV's potential for disruptive developments, venture capitalists have put only about $700 million into CPV companies since 2006, compared to $3750M for crystalline silicon PV and $4400M for thin film, according to Bloomberg New Energy Finance.

But things are looking up. Sunny Spain's brief fling at flinging money at solar technology funded several modest CPV installations that have now been in the field for a couple of years, providing real operating data to reassure investors. And some US states' requirements for utilities to get 20% or more of their power from renewable sources in coming years has utilities in the sunny US Southwest willing to consider the potentially lower cost technology, and some CPV projects winning power supply contracts in competitive auctions. Amonix won 28.5MW of PPA, spread across four separate projects, in Southern California Edison's November bidding round, though the vast majority of the 240MW in total contracts went to flat-plate PV projects. Xcel Energy has contracted to buy the power from a 30MW project from Cogentrix Energy in Colorado that will also use Amonix CPV systems. It looks like there's now some 100MW to perhaps at best 150MW in the pipeline for installation in 2011.

Still, suppliers shouldn't underestimate the risk aversion of investors and utilities, and the tough competition from established flat-plane PV, which just keeps getting better and cheaper. A comparison chart from Antonio Marín Marín, director, project finance, West LB AG, at the recent CPV Summit in Sevilla said it all- Si PV: proven during more than 30 years; CPV: no meaningful track record.

What's needed next: Scaling production, reducing variability all through the system

An encouraging sign is the start of at least some scaling of automated production at several of the leading CPV producers. Amonix argues that the low capital costs involved in manufacturing CPV modules make rapid scale-up possible, and significant economy of scale will be obtained when production reaches the tens of MW in 2011, and expects that this scaling will reduce the levelized cost of electricity of CPV down to less than single-crystal silicon PV. Alatz Aurtenetxe, CEO of Guascor Foton—which has 11.5MW of CPV installed in Spain—sees opportunity for a 48% cost reduction over the next 5-10 years, if the market scales to volumes. Most of that will come directly from economies of mass production (20%) and other improving manufacturing processes (10%), the rest from improved efficiency and general product maturity. The cell and optics module currently accounts for about half the cost of a 5MW CPV farm, the balance of systems the other half, particularly the tracker.

Also key to easing investors' concerns is reducing the uncertainty in every phase of the CPV project, where installation costs can vary widely, 25-year module performance is unproven, and actual operating and maintenance costs are unknown. Anything that makes each step more predictable can only help, and there too we will see progress in standardized installation practices or supplierfinanced installation, in certification, insurance, warrantees and bonds for performance, in simpler, more standard operations and maintenance contracts. Even the proliferation of varied technology developments in better cells and optics is a bit problematic, because it leaves investors confused over the options. In fact, even fewer technology choices would help drive the market forward, argues Felipe Hernandez, technology manager for Fotowatio Renewable Ventures (FRV).

Main reliability problems in practice are turning out to be tracker precision and reliability, moisture inside modules, actual module efficiency (vs nameplate), and module mismatch, according to the ENEL testing lab. FRV also notes the need for more reliable and accurate trackers and for CPV- specific inverters.

Scaling production of the multijunction semiconductor cells at the heart of the CPV systems could also make an important contribution to bringing down costs, as volumes now remain very small. Major supplier Spectrolab has shipped about 2 million units of its current generation terrestrial cell. Roughly estimating about 60 cells of around 1cm2 each on a 100mm wafer with high yields, suggests run rates of only about 700 wafers a week for CPV, though the space cells processed on the same line significantly boost the company's total volumes. JDSU estimated 1GW CPV production would consume 20,000 150mm wafers a week. The scant handful of major suppliers currently – Spectrolab, Azur Space, Emcore – still mostly rely on their space cell business, and are watching the CPV market to see if it develops into a significant opportunity to make it worth investing in additional reactors. Another dozen- plus other players tracked by NREL are at least developing multijunction solar cells, including Arima, Epistar and VPEC in Taiwan; CESI in Italy; IQE and Quantasol in the UK; Cyrium in Canada; Sharp in Japan; and JDSU, Microlink, RFMD, Solar Junction and Spire in the US.

Finding enough sites to drive volume

Most CPV suppliers now say they're targeting mid-sized 10MW-100MW installations for utilities' distributed generation, and for commercial and institutional sites, in the sunniest, driest locations where CPV performance most outperforms flatplate PV. But are appropriate sites too limited to drive the volumes needed to be competitive? Experience with trackers in the field shows that while they are very dependable, they do need regular monitoring and oiling and cleaning to keep performance up, so installations will have to be large enough to support paying for maintenance people.

Amonix CPV system will used by Cogentrix Energy LLC - (Courtesy of Amonix, Inc.)

Some of the systems are also gigantic, which allows for efficient automated factory production and quick installation, but means a plate around 350m2 (or 3850 ft2), a foot print larger than many houses, raised up on a pole so it looms up almost five stories tall. That means they'll need a certain amount of out-of-the-way space to not get pushback in populated areas. Open desert areas are ideal, and the CPV installations do take less land, and leave the land underneath relatively undisturbed compared to competing flat-plate or concentrating solar thermal. But those dry and unpopulated areas typically lack transmission lines, and the localities responsible for building the power lines are often not the localities that want the power. The other US Western states are not interested in spending on infrastructure to serve California cities. Some startups are proposing other solutions. One possibility is smaller systems that can be more easily sited close to users, on commercial rooftops, or in the space around other existing generating projects already connected to transmission lines. Soliant Energy (Monrovia, CA) says it has more than 10MW of orders and is ready to scale production of its lighter weight system that's less than a meter tall, with expanding to 40MW production capacity in 2011. The company claims its systems produce electricity at less than $.09 per kWh, about 9% less than thin film, and have a 6.6 year payback, several months less than thin film.

More radically, the Australian startup Sunengy plans to float plastic structures on the lakes behind hydroelectric dams, to use their existing transmission lines, replacing some of the hydro power during the day, while the hydro can be used at night. It also figures it can cut system costs significantly by not having to make the structures strong enough to withstand high winds. Instead the meter-square Fresnel

lenses above the cells automatically rotate down into the water to protect themselves from high winds, so can be made out of low cost plastic, floating on a raft that stops the waves. The company says a 1MW installation would cover a 160m2 area of water, using a mid concentrating system with silicon cells. Tata Power, India's largest private power utility and an investor in Sunengy, reportedly plans a pilot installation.

Moving from government supports to economic drivers
European governments' phasing out of feed-intariffs should help make CPV more competitive with flat-plate PV. Yole Développement expects most of the European feed-in programs to be phased out over the next few years, with the rising perception among European tax payers that their money is mostly funding Chinese PV makers. And indeed the potentially lower cost of CPV technology could help PV in general wean itself away from government supports to become a market driven sector, where more focus on the real cost of all energy projects will likely spur innovation.

Through its Concentrated PV report, to be released early 2011, Yole Développement has assessed where this industry stands. This in-depth analysis covers all the different aspects of CPV such as: Review of the value chain with all manufacturers committed to this industry (cells, modules, and systems), detailed description of the technologies (High-concentration, optics, thermal extraction, etc.), evaluation of the economic drivers (LCOE) and market data forecast.

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